CASE STUDY

January 2018 - Horsham, West Sussex

Eastney Case Study

Project summary:	ERG was contracted by Southern Water to provide increased air extraction and upgraded odour control at the Eastney Headworks site in Portsmouth.
Key project data:	The upgrade works • more than doubled the extracted air flowrate to the odour control unit from 20,700m^3/hr to 48,500m^3/hr • was completed with live sewage flow throughout • maintained air extraction from the underground screens area and detritors throughout • minimised the duration of shut-downs • optimised the re-use of existing assets to keep the project cost as low as possible
ERG project value:	£970k
Project timescale:	Feasibility and FEED: 3 months (2015) Detailed design and engineering: 3 months (2015) Site works: 9 months (2015-2016) All matching Southern Water's requirements

Introduction

Eastney Headworks receives sewage and storm water flows from Portsmouth and provides primary solids removal using screens and detritors prior to pumping the screened sewage to Budds Farms WwTW for treatment. Storm flows are directed to Fort Cumberland for storage and reintroduction to the sewer network post storm event back at Eastney. The sewage flow and pumps are housed underground with only the washpactors, skips, MCCs, facilities block and odour control housed above ground. The original parts of the site date back to 1886 with a significant upgrade (including addition of the odour control block) in the late 1990s.

In 2014, in response to an updated DSEAR assessment, Southern Water upgraded some of the electrical installation and drives in the underground works. The risk mitigation included additional ventilation rates in the detritor and screens areas and so Southern Water engaged ERG, as the framework odour control supplier, to investigate options for improving the ventilation and associated odour control.

Fig 1 – Scrubbers and demister. Temporary / bypass scrubber on left; new main odour scrubber on right

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This case study explains the challenges associated with design and subsequent project implementation, and how ERG successfully installed a system which delivered everything Southern Water needed.

Feasibility and Front-End Design

As part of the Front-End Engineering Design (FEED), ERG's design team worked in collaboration with Southern Water to establish the requirements of their DSEAR report and agree the design extraction rate from each area of the works required to meet the new design parameters. ERG then surveyed the site to establish the currently-achieved extraction rate and operating approach and the state of repair of the existing extraction ductwork. Within the headworks, there were two generations of extraction ductwork, some of which worked adequately, although parts were in a poor condition and provided no extraction.

ERG had been maintaining the odour control unit for over a decade under a framework contract with Southern Water (SW). Therefore, our maintenance and operations staff knew the SW site team well, and had a good understanding of the existing odour control package.

The output from the FEED was a report of recommended works which included current and future air flow diagrams, ductwork P&IDs, and upgraded odour control unit outline design. Following review and approval by Southern Water's engineers, this plan formed the base-line for a subsequent proposal and contract award.

Project Implementation

ERG implemented the project successfully to six key criteria:

1. **Increase the extraction rate from site to meet the DSEAR report requirements**

This meant an increase from the detritors from 2,400 to 8,900m^3/hr and from the headworks screen room from 5,600 to 20,400m^3/hr. The total extraction from the combined areas therefore increased 365%.

A practical limitation for the new design was the size and position of the ductwork penetration through the screen area ceiling slab. Lack of available civils drawings for the structure meant that new openings in the slab were risky and so ERG re-used the two existing duct sections passing from the underground area into the existing ductwork network. And new, dedicated detritor area extraction ductwork was routed above ground to combine with the balance of the screen area extracts.

Fig 2 – Detritor extraction and air admittance dampers and ductwork and screens area

In normal operation, balance air cascades from the screen area into the detritors. But during storm events, the higher liquid level blocks this air path, and so to ensure continued detritor extraction, ERG installed air admittance ductwork with weighted air inlet dampers. These inlet and exhaust ducts to the sealed detritor area made use of existing penetration through the 1100mm thick detritor structure wall in order to reduce the scope of new civils works, although one new penetration was required.

Fig 3 – New penetration through the detritor wall for the new odour control extraction duct

The storm pumping station was also ventilated at a higher rate, increasing from 12,700 to 19,200m^3/hr. By careful design of the new ductwork system, ERG was able to retain the existing ductwork between this PS and the odour control building without modification.

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The combined air flow to odour control therefore increased 235% from 20,700 to 48,500m^3/hr. Within the underground detritor and screen areas, ERG designed and installed all new PVC extraction ductwork with room grilles and droppers to specific areas, with all parts designed to robustly resist storm event surcharging, while being free-draining, easy to clean and still capable of providing extraction during the storm events. Above ground, ERG's new ductwork system was PVC/GRP, and took into account all building and road access requirements, with high-level supports and a pipe bridge across a road. This above ground system also included bespoke connections at the screen area floor slab penetration, and allowed for the existing power and lighting services within the odour control building.

Fig 4 – New pipe bridge and ductwork from detritor and screens area

ERG's scope also included for the refurbishment or replacement of Air Handling Units (AHUs) to provide fresh-air ventilation into certain of the buildings and underground areas, ensuring positive air pressure to prevent fugitive leaks of odorous air and associated H_2S corrosion of electrical components.

2. Treat the extracted air to at least the same odour discharge standard

The original (20,700m^3/hr) odour control unit was a two-stage chemical scrubber. From our maintenance activities and site monitoring, ERG knew that the first stage acid scrubber was not required since the ammonia levels from the site were very low. All of the odour performance could therefore be achieved using a caustic-bleach scrubber for H_2S and mercaptans removal. The existing second stage scrubber performed well, but was undersized for the new, higher airflow and was mechanically failing. ERG therefore agreed a new caustic-bleach scrubber approach with Southern Water, including supply of a new scrubber vessel.

Fig 5 – New demister with support structure and existing carbon filter with access. Chemical storage and dosing room behind

Because the odour control building height was not sufficient for the new scrubber, ERG's design split the scrubber into two, incorporated a vertical scrubber and a separate horizontal demister vessel, mounted at high level in the building. This maximised the height in the scrubber available for packing, and hence provided the greatest scrubbing efficiency possible.

The treated air was designed, and subsequently measured, to be less than 10ppb at the stack, which matched the original treatment requirement for the site.

3. Minimise the impact on the site's neighbours and Southern Water staff during the upgrade works

The site is bounded by residential properties, with the closest neighbour less than 30m from the odour control discharge stack. ERG's site and project managers work closely with Southern Water to ensure the works ran to programme, and that SW's communications team were able to keep their neighbours fully informed about the works. Noise, dust and traffic nuisance were all carefully thought through and managed, but the biggest perceived nuisance was from odour. ERG's design placed significant value on implementing temporary odour control.

ERG planned the works scope and sequence carefully. In the odour control building, the (now

redundant) first stage scrubber was converted into an H_2S odour scrubber, and modified to make it more efficient. And temporary ductwork in the building allowed this scrubber to be used as temporary odour control for the majority of the works. This included modifications to the scrubber orientation, access structure and dosing system, much of which is retained for future standby capacity.

Fig 6 – Modification of original acid scrubber to provide temporary odour control

In total during the 9-month site programme, the extraction and odour control system only needed to be switched off on two occasions, each less than 8 hours, and there were no complaints from the site's neighbours as a result of the upgrade works. In fact, the total number of odour complaints from the site has been zero in 2016 and 2017, a fall from 4-5 per year in 2014 and 2015.

Southern Water and ERG staff needed to access the screen and detritor underground areas throughout the project, and ERG's temporary extraction system also ensured that the H_2S concentration in the underground areas was kept at or below the safe level of 5ppm. ERG's site manager liaised daily with the Works Manager to co-ordinate entry into the underground areas. This worked extremely well due to the long-standing trust SW had developed in ERG's staff and attitude to work.

4. Execute all works safely

ERG acted as CDM designer and principal contractor.

The underground sections of the site contained live, flowing sewage throughout the project. ERG's primary concern was therefore to complete the project without accident.

Four particular areas of risk were identified:

- **Access within the underground areas**. Fitting and commissioning new ductwork, and removing redundant ductwork above live sewer channels required permanent scaffolding which itself had to be erected and disassembled with the site live. ERG worked closely with the scaffolding contractor to ensure all RAMS were adequately robust and that the scaffold erection and modification occurred at times of dry weather sewage flow to limit the risk of surge liquid levels being encountered.

Fig 7 - Underground ductwork – accessed from scaffolding above the live inlet channel

- **Ventilation of all man-access areas to maintain a safe working atmosphere**, as noted above. This was achieved by using the original ductwork underground connected via temporary and new ductwork to the temporary odour control system while the new underground and above ground ductwork was installed and brought on line. In particular, the duty/standby fans were retained for this ventilation and replaced one at a time by the new, larger duty fans. The new fans were fitted with new incomers and VSDs to allow them to initially operate at the 20,700m^3/hr flowrate before being recommissioned towards the end of the project at the new design flow.
- **Lifting and working at height for the install of the new scrubber**. ERG's temporary works design included a scaffolding gantry and runway beam to allow installation of the new odour scrubber. This scrubber was fabricated at ERG's sister company, ERG Plastic Fabrication, and designed to be installed in bolted sections – and the building layout dictated that the scrubber

had to be positioned in the least accessible corner of the building. Bypass and permanent ductwork also needed to be installed.

- **Chemical storage upgrade**. The increased scrubbing duty required additional chemical storage on site. ERG decommissioned the existing chemical store (of caustic solution, bleach and sulphuric acid), modified the bunding and dosing pipework, and then fitted a new dosing and storage package with increased capacity. And during the change-over, ERG arranged temporary dosing from IBCs.

Fig 8 – New bleach tanks in the chemical store

There were no serious incidents during the site activities – a testament to ERG's planning and site management.

5. Retain system flexibility for future operations

The original acid scrubber, re-purposed to be a temporary caustic-bleach scrubber, was retained in the system to act as a standby or bypass scrubber. Although only rated for 40% of the design flow (ie 20,700m^3/hr), it can be used in combination with the original bypass carbon filter to provide approx 50% of the design ventilation requirements when the main scrubber is off-line for maintenance. ERG designed and installed the necessary ductwork bypasses and controls to make this a straightforward operation when required.

6. Re-use existing assets where possible to keep project costs to a minimum

ERG re-used numerous items of existing equipment within the design. The purpose of this was to provide good value for money, to make best use of assets which still had capital value, and to assist with system implementation. A few examples include:

- The original system had a main discharge flue and a secondary flue for the bypass carbon filter. In the uprated system, ERG fitted an interconnecting duct to allow these stack flues to operate in parallel, and enlarged the connections onto the stacks to take the larger air flow – and all within the tight confines of a concrete structural chimney. This innovative solution avoided the construction hazard and risk to the project budget and programme of removing the original flues and fitting a new, larger, single flue stack.
- This also allowed the original, and well maintained, stack monitoring system to be retained without modification.
- The recirculation pumps and pipework on both scrubbers were retained, although the pumps on the new scrubber had new impellers fitted and were repositioned. A simple modification which avoided the cost of replacement pumps.
- ERG kept all of the buried ductwork from the storm pumping station, and within the odour control building we were able to reuse most of the installed ductwork manifold around the original first stage scrubber. Careful surveys and detailed drawings allowed ERG to integrate the new equipment smoothly with the original system.
- The complete carbon filter bypass system, which provides ventilation at the inlet to the screens, was retained without modification.

Summary

ERG completed this technically demanding upgrade safely, to budget and on time. Southern Water's operations suffered only minor disruption during the works, and the impact on the site's neighbours was kept to an absolute minimum. All of this was achieved by ERG's experienced design and project management team working extremely closely with SW's teams, developing a robust and pragmatic integrated design and installation plan for the upgrade, the temporary works, and the interface between the two. The success of this project is down to the people involved.

Further information

For further information and enquiries, please contact:

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About ERG (Air Pollution Control) Ltd.

ERG (Air Pollution Control) is a leading supplier of air pollution control systems and services with a 35 + year track record, providing turnkey tailor-made solutions that are optimised to give the best technical solution for the lowest capital and running cost.

ERG is based in Horsham, West Sussex, near Gatwick airport with satellite offices around the UK, a branch office in the Middle East, and a global network of V-tex® technology licensees.

ERG specialises in odour control and gas conditioning systems; V-tex® scrubbing, stripping and condensing technology; soluble contamination capture and recovery; particulate removal systems; hazardous waste flue gas cleaning systems, and VOC contamination abatement.